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COMMON COUNTRY ROADS.

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(BULLETIN SPECIAL.)

COMMON COUNTRY ROADS.

The Ontario Department of Agriculture is indebted to Mr. Isaac B. Potter of New York, Editor of *Good Roads*, for permission to use the following extracts from the pamphlet prepared by him and entitled "Country Roads." The pamphlet is copyrighted, and is published by the New York State Division of the L. A. W.

The country road is part of the machinery of agriculture ; just as the steel track is part of the machinery of the railroad. The farm waggon should pass over the surface of the road, and every pound of effort spent in dragging heavy loads through the deep mire is a waste which every farmer should strive to avoid.

DRAINING OF ROADS.

Mud is the greatest obstacle to the travel and traffic of the farmer. Mud is a mixture of dirt and water. The dirt is always to be found in the roadway ; and the water, which comes in rain, and snow and frost, softens it ; horses and waggons knead it and mix it, and it



FIGURE 1.

Showing proper form of ditch to be dug along the side of the country road. The sides are broad and flaring and have slopes of " $1\frac{1}{2}$ to 1 ;" that is, the slope extends outward a horizontal distance of $1\frac{1}{2}$ feet for each one foot of vertical rise.

soon gets into so bad a condition that a fairly loaded waggon cannot be hauled through it. We cannot prevent the coming of this water, and it only remains for us to get rid of it as soon as possible. Very few of us know how great an amount of water falls upon a country road, and it may surprise some of us to be told that on each mile of an



FIGURE 2.

Showing form of side ditch frequently seen along country roads. The sides of the ditch are too steep and quickly "cave in" at sides and edges, thus obstructing the flow of water at the bottom. This form of ditch is also dangerous to travellers.

surplus water. To state it briefly, *drainage is the first and most important thing to be attended to.*

SIDE DITCHES.

The road must have side ditches, of course. Side ditches catch the water which runs from the surface of the roadway and from the surface of the ground on each side of the road; they also receive the drifts of snow which are scraped from the roadway in winter, and the water which comes from melting snow and ice in the spring. A side ditch should have a gradually falling and even grade at the bottom, and broad, flaring sides. Look at Fig. 1. It shows you the form which a side ditch should have. Its banks will not cave in. It can be easily cleared of snow, weeds and rubbish; the water will run into it easily from each side, and it is not dangerous to waggons and foot travellers. It is therefore a much better ditch than the one shown in Fig. 2, which represents the kind of ditch very often found along the country roadside.

To make the ditch shown in Fig. 1, and to make it with even flaring sides, so as to produce a workmanlike job, we had better use a rough gauge like that shown in Fig. 3.

This gauge is made to fit the proper cross section of a good surface ditch, and by "fitting" it in the ditch as we go along, the shape

ordinary country highway (three rods wide) there falls each year an average of twenty-seven thousand tons of water. Water is a heavy, limpid fluid; hard to confine and easy to let loose. It is always seeking for a chance to run down hill; always seeking to find its lowest level. In the ordinary country dirt road the water seems to stick and stay as if there was no other place for it; and this is only because we have never given it a fair opportunity to run out of the dirt and find its level in other places. We cannot make a hard road out of soft mud, and no amount of labor and machinery will make a good dirt road that will *stay good* unless some plan is adopted to get rid of the

drainage is the first and most

of the ditch will be kept uniform and correct. The gauge can be made of any convenient strips of wood. The upright strip is four feet long. The horizontal strip is 18 inches long from the left side of the upright piece (as you face the figure) to the point of gauge at the extreme right and the top of the horizontal strip is one foot above the bottom point of the gauge.

LOCATION OF SIDE DITCHES.

If possible, the side ditch should be about three feet from the edge of the travelled roadway, and there should generally be a side

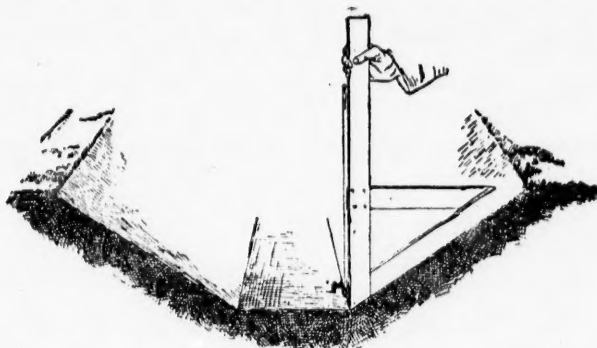


FIGURE 3. SHOWING HOW THE DITCH GAUGE IS USED.

The bottom of the ditch may be from six inches to one foot wide. The gauge is provided with a plumb line, fastened to the upright strip, as shown in the figure, and by this means the upright piece is held vertical and the slopes made to correspond with the edge of the diagonal strip.

ditch on each side. If the travelled roadway is fourteen feet wide, there will then be twenty feet of clear space between the ditches; if the travelled roadway is sixteen feet wide, there will be twenty-two feet of clear space. Now and then we shall find a place where the roadway is too narrow for these figures, and in such cases we may have to get along with a single ditch and a narrow roadway. *The best rule is the rule of common sense.*

Sometimes side ditches are entirely omitted and the shallow gutters at the sides of the waggonway are depended upon to carry off the surface water.

These gutters sometimes serve a good purpose, especially when made in regular shape and with good grade (as can be done with a good road machine), but they are likely to clog and be destroyed by

passing waggons, and for this reason alone it is better to make one or more separate ditches when possible.

Common side ditches catch surface water, and surface water alone. When the surface of the roadway become rough and rutty by the passing of waggons, the ruts and low places hold the water and prevent its passage into the side ditches, and although these ditches carry most of the water which falls, there is often enough left in the roadway to create deep mud and produce much harm. In spring the frozen ground prevents the water from passing downward into the soil, and it remains to form mud on the surface.

UNDER-DRAINS.

No way has yet been found of getting entirely rid of this mud, but in nearly every dirt road we can secure great improvement and obtain a dry road nearly the year round by the use of a single line of under-drain. It is safe to say that there is scarcely a dirt road in the country which cannot be so improved by under-draining as to yield benefits to the farmer a hundred times greater in value than the cost of the drain itself.

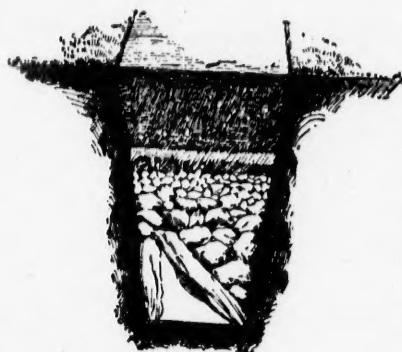


FIGURE 4.

Showing form of under-drain made with field stone. The ditch is first dug and carefully graded at the bottom; then large flat stones are carefully placed at the bottom so as to form a clear passage of good size for the flow of water. The ditch is then half filled with rough field stone (with small sizes on top), and on these a layer of sod is placed with the grass side downward. The rest of the ditch is filled with earth. If sod is not to be had fine brush, hay or straw may be used instead.

Under-drains are cheap, and are easily made. If made in a substantial way and according to the rules of common sense, a good under-drain will last for a generation without repairs. It is best and cheapest to use drain tiles when possible; but if, for any reason, we cannot use tiles, common field stone may be used instead. The drain ditch should be dug in a line parallel with the road, and it may be either in the centre of the roadway or on one side of it. If the ground is soft and "springy" it is all the more necessary that an under-drain should be laid. If it cannot be laid in the centre of the

road without seriously interfering with the passage of waggons, the ditch can be dug on one side of the roadway and between the road-

way and the ditch. It should not be less than four feet deep from level of land before roadbed is rounded up, and this depth will, in most cases, be about right. If we decide to use field stones, we should select flat ones to form the opening or channel at the bottom of the drain, and they should be laid with care, so as to leave a good sized opening, as shown in Fig. 4. The method of building this drain is described briefly in the text under the figure. In laying all drains, begin at the lower or downstream end, so that whatever water runs into the ditch will be carried out through the drain as you go along with your work.

TILE DRAINS.

If a tile drain is used we must select hard burned tiles, such as are used for farm drains, and in most cases a three inch tile will generally be large enough to completely drain the soil beneath the roadway. Such a tile will pass about thirty-five gallons of water per minute when laid on a grade having six inches fall per hundred feet. But a larger drain is never out of place in a roadway, and it is better in some ways than the smaller one. It admits more freely the warm air in spring, and hastens the thawing of the frost and the drying of the road.

Drain tiles are made in different forms. The round tile is generally the best, although some people prefer a form known as "sole tile," because it has flattened upper and lower surfaces. This advantage is more imaginary than real, as the round tile is more easily fitted end to end, and besides this the round tile is always lighter, less bulky and can be carried about at less expense and with less labor. The price of the two is about the same.

If we decide to lay our under-drain along the centre of the road, we may, if a good quality of gravel is found in the neighborhood, get a very good roadway by following the plans shown in Fig 6, in which the method of construction is briefly described under the figure. If no gravel is found, and the earth is of a clayey and sticky kind, we may follow the plan described on page 10.

THE SURFACE.

The surface of the road should be smooth, for smoothness means easy hauling. The surface of the road should be hard, for hardness prevents the formation of ruts and the sinking of wheels into the surface. Besides a hard road surface will shed water quickly, and if water is quickly carried off, the roadway will be kept dry, and the formation of mud holes avoided.

A plow should not be used in working a dirt road except when actually necessary, because a plowed surface is difficult to make smooth and hard and the plow is likely to cut too deeply into the earth. We should, by all means, have a good road machine,

if possible. These machines are sometimes called "scrapers" and sometimes "graders." A good road machine will do the work of twenty laborers, and when put to its best it will do the work of forty. Besides, it will be done uniformly and thoroughly. The best time to use a road machine is when the road is not too dry, and the best way to use it depends upon the machine we are using. Each manufacturer aims to get the best work out of his machine, and to use it so as to give the best satisfaction to the buyer. He will tell us how to use it to the best advantage, and by following his directions as closely as possible, we shall be sure not to go far astray.

The following points taken from the printed instructions sent out by one of our leading road machine companies, will be found generally useful :

SUGGESTIONS TO OPERATORS AND POINTS TO BE CONSIDERED IN SELECTING A ROAD MACHINE.

To the fair-minded, intelligent road official of the present day, there is no question as to the many advantages of road machinery over any other method of repairing dirt roads.

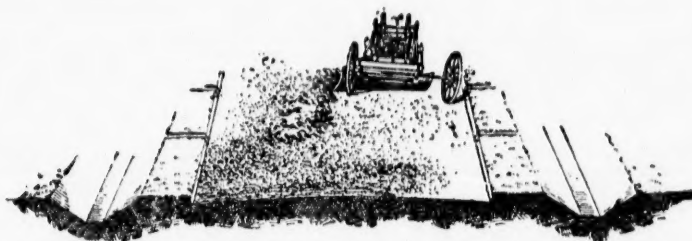


FIGURE 5.

Showing proper form of country dirt road. There may be only one side ditch when space is scant, but two are always better. A strip of sod three feet wide runs along between the ditch and roadway. The roadway may be from eight to fifteen feet wide, according to the amount of travel, and is connected with the side ditches by short drain ditches, running across the grass strip at frequent intervals. The figure shows a road machine employed in repairing the roadway.

Besides doing the work at less than half the cost, vastly better results are obtained. The difference between the results obtained by the use of a road machine and the old-fashioned plow and shovel method is clearly defined. A road machine of recognized merit will plow an even ditch of uniform depth, and will plow where an ordinary plow will not enter the soil. The scraping blade of the machine moves the earth from the ditch to the middle of the road, distributing it evenly and leaving the roadbed smooth, without any

of those little bumps and holes which characterize a road repaired in the old-fashioned manner. These bumps and holes, small at first, will wear larger, and soon develope into good sized ruts, making the road very unpleasant to travel over.

It is conceded that a good reversible machine will do the work of from thirty to forty men in the ordinary work of road construction, thus effecting a saving of more than one-half over the old methods.

SUGGESTIONS TO OPERATORS.

In the work of operating a road machine, as in everything else, experience is the best teacher. . . . Machines are so simply constructed that any man with ordinary intelligence, after he has acquainted himself with the different adjustments, will, with a very little practice, be able to operate the machine well under all circumstances. A slow, strong motion is indispensable to good work.

REPAIRING.

A little timely work done in the right way is like "the stitch in time that saves nine." No matter how nicely and well a road has been made, travel, rain and frost all combine to destroy it.

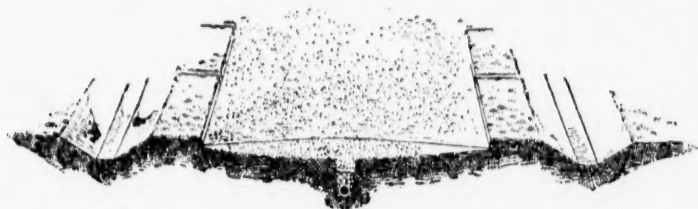


FIGURE 6. A GRAVEL ROADWAY WITH UNDER-DRAIN.

When clean gravel of good quality is used, this makes a very excellent form of country road. The centre drain may be either of field stone or tiles, and is made as already described in Fig. 4. The gravel should be clean and "sharp" so as to pack and drain quickly and should contain very little soft earth, which always holds water and forms mud. A gravel road is always improved by keeping the surface in proper form and by rolling with a heavy roller.

There is hardly a month in the open season when the road machine cannot be used to advantage in the road, but spring is the best time to do efficient work, because the soil is loose and roots of grass and weeds do not interfere. Every spring, before the ground becomes too hard, the road should be gone over thoroughly with a road machine; the ditches cleaned out, so that water may have a free

outlet; ruts and holes filled, elevations in the road and the shoulders on the side of the road planed off, the grade improved and the road put in a good condition generally. In repairing a road which is in fair condition, commence at the ditch and work towards the centre, scraping lightly with the entire length of the blade, till the last rounds in the middle of the road, when the rear end of the blade is carried high enough to allow the earth to distribute under it. To make the blade penetrate very hard, stony ground, it may be best to use only the point, elevating the rear end considerably. The best finish can be obtained in sod ground by first cutting the sod as thin as possible, then placing them in the middle of the road, and finally going back to the ditch and bringing up earth and levelling over the sods. Ruts or depressions that are too deep to be filled with the machine should be filled in with gravel. Do not fill in more than is necessary, only sufficient to fill the holes.

When gravel or sand cannot be obtained the improvement of a clay road is sometimes difficult. A good under-drain may be laid along the centre of the road and the earth removed from the roadway to a depth of about one foot at the centre, from which point the excavation should rise by a gradual slope to each side. On the bottom of this excavation a layer or bed of hay, straw or coarse grass should be laid to a depth of about four inches (when compacted) and the earth should then be filled in and formed to the true shape of the roadway. This method of treatment will tend to keep the roadway dry and prevent the formation of mud. When the road runs down hill the short ditches connecting the roadway with the side ditches are made with a diagonal pitch down the grade so as to catch the running water in the roadway and carry it to the side ditches.

HOW TO BUILD NEW ROADS.

In building new roads with a machine first mark out your ditches the full width, plowing a light furrow with the point of the blade, carrying the rear end well elevated. On the second round drive the wheels in line with the point along the hollow made the first round, plowing a full furrow with the advance end of the blade, dropping the rear end somewhat lower than before. The third time round move over towards the middle of the road the earth previously plowed. Then return to the ditch and plow it out deeper, moving the earth towards the middle whenever as much earth is plowed as the machine can move at once. Repeat this until the ditches are the proper depth, and the road as full and round as required; then surface off as directed in repairing.

POINTS TO BE CONSIDERED IN SELECTING A ROAD MACHINE.

In the selection of a road machine the following points should be carefully considered :

1. Thoroughness and simplicity of its mechanical construction.
2. Material and workmanship used in its construction.
3. Ease of operation.
4. Lightness of draft.
5. Adaptability for doing general road work, ditching, etc.
6. Safety to the operator.

WIDTH OF TRAVELLED ROADWAY.

The travelled part of the road should be of uniform width, and the two sides should be parallel, if possible. Sometimes a width of ten feet will be enough ; but sixteen feet is about right where much travel is to be provided for. It will be seen in this figure that the work of the road machine has formed two gutters on the outer edges of the road, and these gutters are sometimes depended on to provide for all the surface drainage of the roadway. As a general rule, it may be said that this form of construction is cheap and faulty. These shallow gutters or ditches become easily clogged by passing waggons and by loose dirt. They are not large enough to contain and carry off all the water of heavy rains and melting snows, and for this reason the surface ditches described in the preceding chapter should not be omitted. These surface ditches should be connected with the roadway by narrow surface drains placed about ten yards apart along the line of the road, and on all steep grades these narrow drains should run diagonally downward from the roadway to the surface ditch. If made in this form they will catch the water easily as it runs down the hill, and carry it quickly into the side ditch, where it properly belongs.

FORM OF CROSS SECTION.

The cross section of the road surface should slope in straight lines from the centre to either side. If slightly rounded, no harm will be done, but if much rounded the waggons will naturally follow each other along the centre of the roadway and avoid the steeper parts at the sides.

ROLLING.

Every road is made smoother and harder by rolling, and dirt roads are no exception to this rule. We have all noticed that the hardest and smoothest parts of a country road are the narrow strips which mark the passage of the waggon wheels that have gone over it, and these parts have become hard and smooth because the wheels

have acted as rollers. But a waggon wheel is not always a very satisfactory roller, for the reason that the wheel tires are too narrow, and when the road is wet and soft the narrow wheels sink into the surface and form ruts, and cut and mix and mangle the dirt out of all reason, and destroy the good qualities of the roadway. If all the waggons used on country roads could be provided with tires four inches wide, they would roll the surface more smoothly and more quickly, and it would be in fairly good condition for nearly the whole year round. A good horse roller will serve much to cure this difficulty.

Rolling should follow closely upon the work of the road grader or scraper, so as to consolidate all the loose earth which the action of the scraper has laid in the line of the roadway. The roller should pass many times over the softer portions of the road, and where the road is very dry and not inclined to pack it may be slightly moistened to hasten the action of the roller. The rolling should begin at the sides of the road and work gradually towards the centre; that is, the roller should be passed from end to end along the side of the road and then the second passage of the roller should slightly lap the first until the centre of the road is reached.

THE EARTH IN THE ROADWAY.

Clean gravel is always desirable, and should be used wherever it can be obtained. If the soil in the roadway is found to be of a sticky, clayey nature, we can improve it greatly by adding a few inches of sand, and repeating this operation every few months, as the sand works into the clay. If the soil is composed of loose sand we can greatly improve the road by adding a layer of five or six inches of stiff clay.

In the first instance the sand tends to counteract the stiff and sticky qualities of the clay, and in the second case the adhesive quality of the clay counteracts the looseness and shiftiness of the sand and helps to stiffen it and hold it together. A little study and application of common-place rules in each locality, aided by a few experiments, will generally enable us to arrange the clay and sand so as to give the best results.

CROSS DRAINS AND CULVERTS.

Here and there along nearly every country road we find a place where the roadway is crossed by a small stream, and where the stream is not so large as to demand the construction of a bridge or a culvert a small cross drain may be used as a channel to conduct the water across the road; but this drain should be substantially made, so as to be solid and permanent, for the caving in or washing out of a badly built drain has broken the leg of many a good horse, and has

brought disaster to many a traveller who has staked his faith on the fidelity of a shiftless and incompetent pathmaster and gone abroad at night on the country highway.

WOODEN CROSS DRAINS.

Wood is perishable and is not well adapted to the making of drains, but it is cheap and in many localities it is the only available material from which a drain can be made at a reasonable cost. If stone cannot be had and drain pipe is out of the question, a substantial cross drain can be made of flattened timbers and planks as shown in Fig. 7.

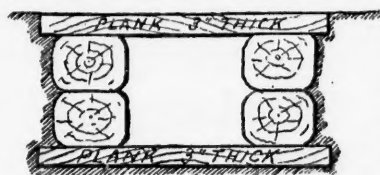


FIGURE 7.

WOODEN CROSS DRAIN.

In making this drain the trench is dug across the road in the line of the drain and of sufficient depth and width to contain the timber and planks. Then the bottom is carefully formed so as to make a smooth, solid foundation, having a slight grade or pitch in the direction in which the water is to run. Two flattened timbers are then laid at some convenient point on the roadway near the drain and so placed as to be parallel with each other and as far apart in the clear as they are designed to be when placed in the drain. A course of three-inch plank is then spiked across these timbers from end to end, using 50-penny nails for this work, until the course of planks extends from end to end of the timbers. This row of planks is to be the bottom of the drain and when the short bottom planks are securely spiked to the timbers, the timbers are turned over (thus bringing the planks at the bottom) and placed in the pit dug to receive them. After this is done another pair of flattened timbers are placed on the top of the first course already in place, and three-quarter inch augur holes bored through the centre of the top timber and half way through the bottom one, about three feet apart throughout their entire length. Into these augur holes should be driven, securely, drift bolts, three-quarters of an inch square, and of sufficient length to fill the augur holes, and the timbers are thus securely fastened together. In the same way, if necessary, another course of timber is put on top of the ones already in place, till the drain walls reach the height of the surface of the road, after which another course of three-inch plank is securely spiked crosswise over the top of the drain, and, over this, for greater strength and permanence, it may be well to spike a layer of three-inch plank endwise across the roadway or at right angles with the shorter planks which are spiked directly to the timbers.

Other forms of wooden culvert will suggest themselves to the ingenious mechanic, and no single plan can be suggested which may not be more or less modified to advantage to meet the conditions presented in different localities.

PIPE CULVERTS.

A good pipe cross drain or culvert will last for many years and will supply a regular and sufficient water-way, and one that is easily cleaned; and if the top of the pipe is set a foot or more below the surface of the road, so as not to be injured by contact with the waggon wheels and horses' feet that pass over it, such a drain is probably the best that can be used on a common dirt road. Cement pipe may sometimes be used to advantage if made by a reliable manufacturer; but vitrified stone pipe is generally more reliable and more durable. Only the "salt glazed" pipe should be used.

When pipe is used for a cross drain or culvert a substantial face wall or abutment should be built at each end to contain and protect the ends of the pipe. The bottom of the abutment should be located far enough below the bottom of the pipe to escape the effects of frost which might heave and disrupt it.

These face walls or abutments may be made of common rubble masonry, in which the stone should be laid in strong cement mortar and well bonded.

If our roadway is provided with a centre drain, or if an under-drain has been placed at either side of the road, we had better put branch pipes in the line of our culvert to receive the water from the under-drain in the roadway.

Each length of drain pipe has a "socket" end into which the plain end of another length is made to fit. In laying the pipe drain the bottom of the trench in which it is laid should be made solid, and should have a form and grade corresponding to the form and grade of the pipe which it is to contain, and little "hollows" should be scooped out across the bottom of the trench into which the sockets or collars of the pipes will fit, so as to permit the body of the pipe to rest on a firm bearing at the bottom and sides of the trench. If the ground is sandy, or of so loose a nature that these depressions or hollows cannot be scooped out, it will be necessary to lay the pipe to grade throughout the length of the drain ditch and then ram the loose sand or earth beneath and around the lower half of each pipe, so as to give it a firm bearing.

The joints of the pipes are sometimes cemented, but there is some difference of opinion on this point, and in most cases it will answer quite as well to cover them securely with stiff clay well packed around the joints.

STONE CULVERTS.

In some localities good stone is plentiful and cheap, and this fact, with perhaps other local considerations, will sometimes make it

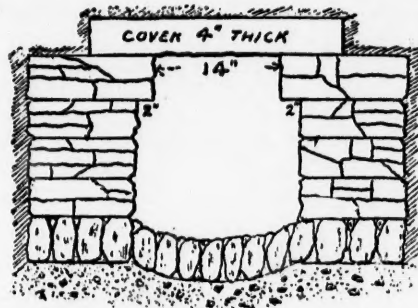


FIGURE 8.

Showing cross section of ordinary stone culvert.

seem best to reject the use of pipe and to construct a stone culvert. In nearly every case rough rubble masonry will answer every purpose.

The following brief suggestions will aid the reader in the general work of planning and overseeing the construction of a stone culvert: As already stated, rough rubble masonry will answer every purpose in making the culvert for an ordinary dirt road, but in laying the stone work plenty of "headers" should be used, so as to give the stone a strong bond, and heavy stones should be used at the angles of the up-stream end of the culvert to resist the action of flood trash and floating ice in the season of heavy freshets. The opening or water-way of the culvert should be ample to admit of the passage of large bodies of water; the bottom of the opening should be paved with stones set on edge and given a downward curve in the centre, something after the style of an inverted arch.

The cover or top stone of the culvert should be at least several inches below the surface of the roadway, and the bottom of the culvert foundation should be below the frost line.

On this subject of drains and culverts, it may be well for the reader to know something of the question of rainfall. Each culvert or drain will naturally be required to pass an amount of water which comes from the adjacent "water shed" (or land from which the water will flow toward and through the culvert). One inch of rainfall per hour indicates a heavy downpour. This amount gives, in round numbers, 23,000 gallons of water per acre per hour, or about 377 gallons per minute per acre. Much of this water will, of course, be held back by various obstacles, and not more than 70 per cent.

will reach the culvert in the hour in which it falls. If a certain water-shed is composed of a thousand acres, then the heaviest rain-storm will pour out upon this water shed about 377,000 gallons per minute, and if the water shed is made up of steep side hills and rocky slopes the water will run off quickly and reach the culvert soon after it falls; while, on the contrary, if the water-shed is composed of flat lands, gentle slopes and porous soils, the water will reach the culvert more gradually, and much of it will be absorbed by the earth.

If drain pipe should be used, it is well to remember that where the road surface is only a short distance above the culvert stream, and the road-maker is thus prevented from using a large pipe, as he otherwise would select, he may avoid the difficulty by using two or more lines of pipe, laid side by side across the roadway, building them into the abutment at each end, as already described in the case of a single pipe.

CONCLUSION.

Many people who have not studied the subject of improved roads do not understand the immense benefit which they bring to a community; yet, of all the thousands of miles of good roads that have been made in this and other countries, the first mile has not yet been found that has not proved to be profitable. The increase in land values alone is always more than enough to pay for the improvement. Some benefits and advantages we cannot always compute in dollars and cents, and some things our common sense impels us to take for granted. No farmer in this country can tell the money value of an education, and yet each farmer concedes its value and sends his children to school, and watches carefully their advancement in knowledge. Good health is of infinite value, and the farmer seeks it and guards it, but he cannot tell its value in dollars and cents. The same is true of good habits, good morals and good clothes. Do not, therefore, waste any time in doubting the value of a good road. The people of other countries who have used bad roads and now use good ones are well satisfied that every dollar spent in this work is a good investment, and not one of them would tolerate the miserable dirt roads with which so many farmers seem to be content.